

Cardiac Arrest in an Obstetric Patient

A Simulated Emergency

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DEMOGRAPHICS

Case Title: Cardiac Arrest in an Obstetric Patient: A Simulated Emergency

Patient Name: Jane Winters

Case Description and Diagnosis: A healthy 32-year-old pregnant woman develops pulseless electrical activity (PEA) arrest at 33-weeks gestation.

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Target Audience: Anesthesia and obstetrics (OB) and gynecology, as well as certified registered nurse anesthetists

CURRICULAR INFORMATION

Educational Rationale

Cardiac arrest during pregnancy is a rare and catastrophic event. More than 50% of reported maternal deaths had some aspect of substandard care inconsistent with current national guidelines.¹ Strict adherence to accepted American Heart Association guidelines, including the modifications that account for changes during pregnancy, is essential.¹ Cardio-pulmonary arrests in OB require that the provider manage a critical situation that most will have never experienced during training.²

Both new and experienced caregivers find cognitive aids (eg, checklists) helpful when managing this type of rare high-risk situation; however, these aids are often not used.³ Despite demonstrated benefits of cognitive aids in medicine and critical care, the integration of those into practice has not been widespread.⁴

In an OB cardiac arrest, there are 2 patients. The best possible outcome for the fetus is the survival of the mother.⁵ This hybrid scenario, using both a standardized patient (SP)

and a high-fidelity mannequin, highlights maternal physiologic changes and the unique elements and knowledge required to adequately resuscitate the parturient.

Learning Objectives

1. Review and address Accreditation Council for Graduate Medical Education core competencies: patient care, medical knowledge, practice-based learning and improvement, interpersonal and communication skills, professionalism, and systems-based practice.
2. Review physiology of term pregnancy: recognize the potential for airway compromise, changes in volume status, and supine hypotension syndrome (medical knowledge).
3. Review and practice basic management of PEA: identify the signs, symptoms, and differential diagnosis of PEA. Review Advanced Cardiac Life Support (ACLS) protocol—identify unresponsive patient, announce urgency of situation and call for help, begin cardiopulmonary resuscitation (CPR), ventilate, and intubate. Treat with appropriate drugs (medical knowledge, patient care, practice-based learning, and improvement).
4. Review and practice management of OB cardiac arrest: PEA is reviewed in the setting of a pregnant patient. Key issues involve recognition of the need for left uterine displacement (LUD), airway changes, and cricoid pressure during ventilation and intubation. The location for CPR will be discussed, as is the need for c-section after 4 to 5 minutes of unsuccessful resuscitation (medical knowledge, patient care, professionalism, systems-based practice, and interpersonal and communication skills).
5. Apply crisis management skills: the learners will demonstrate leadership, assess resources, communicate, distribute the workload, call for help, repeatedly reassess and reevaluate, avoid action and fixation errors, and document (patient care, interpersonal and communication skills, systems-based practice, professionalism, and practice-based learning).

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The authors declare no conflict of interest.

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Debriefing Objectives

1. Define leadership: review resuscitation leadership establishment, recognition and declaration of emergency, calling for help, role and responsibility assignment, and managing conflict and disparate priorities.
2. Address team collaboration: explore recognition and integration of team input, briefing the team continually, and error recognition and correction.
3. Discuss communication practices: review call-outs of critical information, callbacks for confirmation of information, and clarity of roles and responsibilities.
4. Review situational awareness: discuss continued patient reassessment, plan development and execution, task prioritization (ACLS vs. people management), workload assessment, team member cross-monitoring, and requests for assistance.
5. Discuss professionalism: strategize regarding maintaining professionalism in the face of conflict and team member difficulties and for working with a difficult patient and staff.
6. Review the physiology of pregnancy, diagnosis and treatment of PEA, and clinical management of maternal cardiac arrest.

Questions to Guide the Debriefing

- What is the initial response to an unresponsive parturient?
- What is the diagnosis and treatment of PEA?
- What is different about PEA in a parturient?
- How do you communicate with the team?
- Who should lead the team during the resuscitation of a parturient?
- Who should communicate with the family during resuscitation?

Roles/Teams

- Patient
- Anesthesiologist (learner)
- Obstetrician (optional learner)
- Labor and delivery nurses
- Confederates/code team (other course participants) or confederates (actors) sent in as help is requested
- Observer(s) to be the primary debrief team—at least 2, one to watch the video and be prepared to show segments of the video during debriefing and one to watch the scene
- Computer operator—this scenario is preprogrammed and videotaped

PREPARATION

Monitors Required

- External fetal monitor

Equipment Required

- Standardized patient and mannequin should wear the same items:
- Standardized patient in hospital gown, with pregnancy bump and intravenous (IV) tubing taped to her arm
- Mannequin with pregnancy bump, wig, gown, and IV tubing taped to arm

Two sets of Lactated Ringer's (LR) fluid and IV tubing (one for the SP and one for the mannequin) on pump at 100 mL/H

- Noninvasive blood pressure cuff (NIBP)
- Pulse oximeter
- Adult code cart with defibrillator available in hallway
- Epidural cart
- Epidural pump and tubing
- Oxygen tubing
- Bag-valve-mask (Ambu) bag
- Laryngoscope (in epidural and code cart)
- Endotracheal tube (in epidural and code cart)
- Drug syringes (in code cart)
- Stethoscope
- Electronic medical record/patient chart (including prenatal flow sheet, history and physical/emergency department chart, and epidural note as they would be in your hospital)
- Scalpel

Duration

- Before simulation: 10–15 minutes
- Simulation: 20–25 minutes
- Debrief: 30–45 minutes

Room/Mannequin Setup

This scenario requires 2 distinct setups. The scenario begins with an SP lying in bed in the OB ward monitored with an NIBP and a pulse oximeter available for use during epidural placement. The SP has a pregnancy bump concealed by her gown and a secured forearm peripheral IV line with LR solution on a pump at 100 mL/H. Fetal monitors are placed on the patient and set to normal screen.

The mannequin is to be setup on the bathroom floor and programmed for "OB Code" scenario. The "NIBP" screen is paused. The mannequin needs an IV line with the same setup as the patient, that is, LR solution through a pump at 100 mL/H. The mannequin also needs a wig, a pregnancy bump attachment with abdominal overlay for surgical intervention, and a small stuffed doll hidden under the bump. Fetal monitors are on the mannequin, and the fetal heart rate (HR) is normal until code.

Initial patient(s) state:

- SP is on bed talking on a cell phone.
- IV is taped to the arm.
- Fetal monitor is attached to the SP.
- She is wearing a pregnancy bump concealed by a gown.

Stem for the Learner and Observers

The patient is a 32-year-old woman, gravida 2, para 1, at 33-weeks gestation who was admitted to the OB unit with vague complaints of nausea and vomiting, headaches, and fever. Her first pregnancy was uncomplicated. She is otherwise healthy and takes only vitamins. She has not had any prior surgery.

Allergies: Penicillin

Physical examination: the patient has a gravid uterus, otherwise normal. Laboratory results are pending. Vital signs are as follows: HR, 82 beats per minute; BP, 118/55 mm Hg;

respiratory rate, 18 breaths per minute; and a temperature of 36.5°C.

Anesthesia learner: you are the anesthesiologist on the OB service and are awaiting a call from the obstetrician about the patients on the labor unit.

Ob-gyn learner: you are the obstetrician/OB team on duty. You will call the anesthesiologist to inform him/her about your plans to rupture the patient's membranes and start an oxytocin infusion. You will request an epidural.

Information for Scenario Director and Simulation Crew

The anesthesiologist (learner) will interview the OB patient who is going to develop a pulmonary embolus and progress to PEA during the interview. The patient will first be played by an SP and will be replaced by a mannequin once the SP collapses in the bathroom with PEA.

One student is designated as the anesthesiologist. The scenario begins as the obstetrician calls by telephone to tell the anesthesiologist about the patient. The obstetrician will explain that they plan to rupture the patient's membranes and to begin an oxytocin infusion and will then ask the anesthesiologist to place an epidural.

The labor and delivery unit is very busy with 2 to 3 confederates acting as labor nurses. The nurses busily enter and exit the labor room, talking loudly of other patients who are being admitted and are requesting epidurals. They are not addressing the anesthesiologist specifically. The anesthesiologist begins to interview the SP.

If the anesthesiologist asks the nurse to assist while he talks with the patient and prepares to place the epidural, the nurses will say that they will be in after the interview—they have another patient who is about to deliver. If the anesthesiologist insists that a nurse be present, one will stay.

During the anesthesiologist's consultation with the patient and before an epidural is placed, the patient will demand to go to the bathroom. While the learner looks for the nurse to help the patient, the SP goes to the bathroom, where she collapses, and is replaced by the mannequin on the floor. The mannequin is unresponsive and has progressed to PEA. The anesthesiologist must manage the simulated patient.

The learners must discuss when and where to deliver the fetus. It will be important to discuss the indications for performing a cesarean section and the ideal location for this procedure. One confederate nurse will be responsible for providing equipment (ie, scalpel) to the obstetrician but will need to leave the room to retrieve it.

Instructions to Confederates

Patient

This role is played by a difficult patient who is a poor historian. She did not seek prenatal care during pregnancy and has been in the emergency department for 12 hours before being brought to the OB unit. She has been vomiting and has a headache. The patient is going to be very difficult—angry, nauseated, complaining and feeling generally unwell. She will make accusations throughout the interview about the poor care at the hospital and poor quality of hospital employees. At the end of this phase—approximately 3 to 5 minutes, she demands to go to the bathroom, where she becomes unresponsive, and the case transfers to the mannequin. This will

happen when she moves to the bathroom. She does not wait for someone to help her to the bathroom, and she goes alone. While she is there, she moans 3 times and collapses.

OB Nurse

It is a busy day on service, the labor unit is full, and the OB nurse has 2 patients. The other patient is about to push, and her baby has been experiencing late decelerations. The nurse wants to take care of that patient and will be in after the anesthesiologist interviews the patient to help with the epidural. The nurse continues to leave the room to check on the other patient.

The anesthesiologist is left alone with this patient, and the nurse waits for him (or her) to call for help. After the arrest, the nurses arrive to assist. The nurse will help call the code and will go to find the code cart when asked. The nurse takes a full minute to get the code cart and then goes out again to find the patient's chart. The nurse should only act under specific instructions.

Obstetrician

This role is played by either a course participant or a confederate, depending on the demographics of the course on any given day. The OB physician is here to deliver the other patient and is covering the labor unit, so he/she will help with this case. After the arrest, the obstetrician will be called to the room.

Code Team

After the patient arrests, a code will be called. As many people as possible should arrive at the code, so that the anesthesiologist needs to conduct crowd control. Use of several laboratory volunteers and instructors is recommended. They should arrive and remain in the room until they are asked 3 times to leave. Ultimately, the actual code team members are the other participants in the course. They must run the code. They are expected to pick a leader and instruct all confederate members in the code team. The goal is to get them to work together as a team during this crisis to make the diagnosis of PEA, run through the differential diagnosis, and initiate and manage the resuscitation.

SCENARIO PROGRESSION AND FLOW

The anesthesiologist must recognize that the patient is unresponsive, get help, and begin to resuscitate the patient. If the anesthesiologist calls for help, other students are sent in. If the anesthesiologist calls a "code," as many confederates as available that day will be sent in. None of the confederates can lead the code, nor will they offer helpful suggestions. The students in the course are the only people who can run the code; confederates must be told what to do.

Once an appropriate resuscitation for PEA is underway, the patient becomes difficult to ventilate. If the students do not ask (after approximately 5–7 minutes), one of the confederates asks if they would like to see the patient's chart. Similarly, if the students do not ask, one of the confederates asks if they would like the code cart and if they would like additional help.

If the students fail to diagnose the rhythm as PEA, one of the confederates (this role is discussed among the confederates before beginning the scenario) will continue to ask questions

designed to help the students arrive at the correct rhythm and differential diagnosis (Table 1).

DEBRIEFING GUIDE

Note that this scenario is based on a real case, is taken from closed claims information, and follows the events of that case as closely as possible.

We begin with questions designed to encourage the participants to talk about the experience and their actions. The goal is to discuss both clinical management issues and crisis resource management issues. Clinical management issues include PEA diagnosis and treatment and OB cardiac arrest. Specifically, we review maternal physiologic changes such as higher incidence of difficult airway, increased risk of aspiration, and faster onset of hypoxemia due to decreased functional residual capacity and increased oxygen demand. The importance of placing the mother in LUD, need for adequate IV access, and anticipated airway difficulties (eg, edema) are reviewed. Pulseless electrical activity in the setting of the pregnant patient is also explored and focuses on differential

diagnosis and appropriate treatment, including immediate delivery of the fetus via cesarean section. The timing and efficiency of beginning CPR is discussed, as are special considerations of resuscitation in a pregnant woman, such as delivering chest compressions higher on the sternum and removing the external fetal monitor before defibrillation.

Crisis resource management principles are also reviewed. Parts of the scenario are replayed on video, and the timing of critical actions is discussed among the group. The conversation centers on the following actions: recognize and declare an emergency, call for help, communicate with others in the room, establish roles, assess the situation, collaborate in a professional manner with key personnel from other disciplines, and recognize patient/family-specific issues. Focus on decision-making moments—acting under uncertainty while continually reevaluating and managing ambiguity.

Supplemental Material

We have provided references^{6–13} as supplemental materials that may help with the debriefing and may also help the

TABLE 1. Scenario Events

Scenario Flow	Vital Signs	Sim Computer	Key Cues and Actions	Notes
Management of patient interview: angry SP (approximately 5–8 min)	Only fetal HR is monitored. Rate is 130s with good variability Patient is not monitored at this time	No mannequin yet—SP Fetal heart monitor—reassuring tracing with rate in 130s SimMan with wig and pregnancy bump slumped on the bathroom floor. No patient monitors yet; these must be requested	Confederate obstetrician gives a brief, hurried report by telephone. No background or case history is given unless specifically requested. Confederate obstetric nurse is difficult to find and will stay reluctantly if asked multiple times	The SP has many complaints and is agitated. After discussion with the anesthesiologist and before epidural placement, she goes to the bathroom, where she arrests
Patient moves to the bathroom, moans, and then arrests. Management of early arrest—recognition and summon resources (minutes 8–12)	PEA (no pulse) NIBP keeps cycling Pulse oximeter does not record Fetal heart still reassuring (130s) HR, 110–130 beats per min	Unless the patient was placed in LUD and CPR was performed in an appropriate position, it is not effective. Lung compliance is decreased, and there are coarse breath sounds	The student must recognize distress, get help, begin CPR, place monitors, diagnose PEA, and begin to treat. The student must also identify special considerations for OB arrest—LUD, location CPR, and airway changes Sim crew informs the student of whether there is a pulse with compressions. The crew should address airway with ventilation using cricoid pressure—patient may have aspirated; lungs are stiff with coarse breath sounds	If help is requested, send more students and confederates Do they want to move the patient to her bed or proceed with the arrest in the bathroom? Pulses will not resolve unless c-section was performed. Students should declare the need for section and ask for an obstetrician/surgeon to perform section Send in more help if more help is asked for explicitly
Early management of arrest (minutes 13–15)	HR, 80s beats per min and slowing Fetal HR, 80–90 beats per min Saturations were not recorded but were 85%–90%. NIBP does not record	Continue in PEA If the students are managing the case expertly, faculty may create a difficult airway to add complexity If the students experience difficulty with managing the case, faculty and confederates may begin to steer them toward correct diagnosis and management	If students are floundering, simulation crew begins to ask pointed questions to arrive at diagnosis and treatment options	For advanced students, complexity may be added in the form of interactions with the obstetrician or family. These confederates may exhibit a variety of distracting behaviors and will be upset by the situation. For a team that is experiencing difficulty with the scenario, confederates may make proper loud suggestions.
Continued management of arrest (minutes 16–20)	HR slowing to 50s Fetal HR slowing 60s			
Late management of arrest—resolution or imminent death (minutes 21–25)	PEA begins to resolve or worsen	If resolved, HR will be in 80s, there will be carotid and femoral pulses, BP will be 70/40 mm Hg If airway was addressed, saturation will be 92%–95%	Simulation crew will continue to help and provides questions and suggestions to resolve the PEA	Issues of CRM and calling for and using help are discussed in debriefing

student review information. We also include the following information regarding OB cardiac events and PEA as supplemental information given to course participants, along with the referenced articles. We recommend that the maternal cardiac arrest algorithm contained in Hui et al⁹ and Vanden Hoek et al¹⁰ be used (Table 2). It contains the “BEAU-CHOPS” cognitive aid, which we think will prove useful when discussing possible contributing factors and their treatment in maternal arrest.

REVIEW MATERNAL PHYSIOLOGIC CHANGES

- Place the mother in left lateral decubitus position
- Give 100% oxygen
- Intravenous access and fluid bolus
- Look for reversible causes
- Supine hypotension—more than 20 weeks uterus compression IVC and aorta
 - Decreases venous return and cardiac output
 - Impedes chest compression effectiveness
 - Can lead to arrest in a sick patient
- Airway
 - Hormonal changes lead to insufficient GES
 - Airway edema: small tube; early intubation
 - Use carbon dioxide detector to confirm
- Breathing
 - Hypoxemia develops quickly
 - Low functional residual capacity
 - Increased oxygen demand
- Chest compressions
 - Higher on sternum

TABLE 2. Checklist: OB Cardiac Arrest

Action	Time Completed
Call for help	
Airway management	<input type="checkbox"/> Ventilate and prepare to intubate <input type="checkbox"/> Get help with the airway (likely to be difficult) <input type="checkbox"/> Timing of LUD <input type="checkbox"/> Displace uterus (if not already done)
Place patient in LUD	
Circulation: perform parturient appropriate CPR (different hand position and displace uterus)	<input type="checkbox"/> Timing of chest compressions [should be performed as soon as pulseless state is identified and should be performed continually, ideally without interruption (eg, for intubation)] <input type="checkbox"/> Chest compressions position <input type="checkbox"/> Pulse/no pulse
Identify rhythm	<input type="checkbox"/> Rhythm identified <input type="checkbox"/> Treat rhythm
Search for and treat possible contributing factors*	Please see BEAU-CHOPS* cognitive aid
Perform hysterotomy	<input type="checkbox"/> Timing (should be performed within 5 min after parturient arrest) <input type="checkbox"/> Get help for this procedure

*Search for and treat possible contributing factors: the BEAU-CHOPS (Bleeding/disseminated intravascular coagulation (DIC), Embolism: coronary/pulmonary/ amniotic fluid embolism, Anesthetic complications, Uterine atony, Cardiac disease (myocardial infarction/ischemia/aortic dissection/cardiomyopathy), Hypertension/preeclampsia/eclampsia, Other: differential diagnosis of standard ACLS guidelines, Placenta abruption/previa, Sepsis) cognitive aid is useful for this checklist (please see Hui et al⁹ and Vanden Hoek et al¹⁰ as supplemental materials).

- Defibrillation
 - Remove fetal monitor
- Preeclampsia/eclampsia, trauma, drug overdose, toxicity, pulmonary embolus, stroke, and amniotic fluid embolism
- Think of magnesium toxicity—empiric calcium gluconate 1 g (should be administered to reverse magnesium toxicity via peripheral IV line over 3 minutes¹⁴)

PEA DISCUSSION

Diagnosis

- Pulse or no pulse
- Type of rhythm (is the rhythm shockable?)
- Pulseless electrical activity
- Electrical activity and no pulse
 - Prognosis very poor
- Many potentially treatable causes that must be identified to treat and manage the patient
 - Severe hypovolemia
 - Obstruction to circulation
 - Tension pneumothorax
 - Cardiac tamponade
 - Massive pulmonary embolism
 - Pump failure
 - Hypoxia
 - Acidosis
 - Hypokalemia/hyperkalemia
 - Hypoglycemia
 - Hypothermia
 - Toxins
 - Drugs
- Get help, start basic life support, and attach monitor
- Not shockable rhythm
- Give epinephrine 1 mg IV/intraosseous (IO) or vasopressin 40 μm IV/IO
- Repeat epinephrine every 3 to 5 minutes
- Delivery of fetus helps the mother
 - >20 weeks
 - 4 to 5 minutes after arrest
 - Empties uterus and relieves obstruction to venous return and compression of aorta
- Leader needs to think about from start:
 - Can you do it?
 - Do you have neonatal intensive care unit/high-risk neonatal service?

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ERRATUM

Research Abstracts to be Presented at the 13th Annual International Meeting on Simulation in Healthcare, January 26th–30th, 2013 Orlando, Florida: Erratum

In abstract 1396 entitled “Simulation Training Improves Fundoscopic Examination Skills in Third Year Medical Students” which appeared on page 528 of volume 7, issue 6, the author name appeared incorrectly for Dr Silbiger. It was listed as Sharon Silberger and should appear as Sharon Silbiger, MD.

REFERENCE

Research Abstracts to be Presented at the 13th Annual International Meeting on Simulation in Healthcare: January 26th–30th, 2013 Orlando, Florida. *Simul Healthc* 2012;7(6):528.